

# Fig Wasp (Hymenoptera: Chalcidoidea: Agaonidae, Pteromalidae, Eurytomidae and Ormyridae) and *Ficus* (Moraceae) Species Richness and Biogeography of Monts Doudou in Southwestern Gabon

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Thirty species of Chalcidoidea were reared from figs of three *Ficus* species (*F. sansibarica macrosperma*, *F. louisii*, and *F. elasticoides*) that were sampled on Monts Doudou, of which 28 are new records for the country, more than doubling the number of species previously known from Gabon, all of which were recorded from the vicinity of Makokou. Even though the majority of the fig wasp species sampled on Monts Doudou are currently only known from Gabon, their host fig tree distribution suggests that they will be more widespread through the Congo basin or even further afield. Of the 105 Afrotropical fig tree species, 47 are recorded from, or predicted to occur, in Gabon, illustrating the rich representation of *Ficus* species present in the country. These fig tree species are listed, together with the known fig wasps associated with each host tree. Based on current data, a conservative species richness of 225 fig wasps is associated with *Ficus* species in Gabon. The expected species richness, however, is likely to be closer to 400–500 species. Twenty to thirty-five fig tree species are predicted to occur on Monts Doudou, which from a *Ficus* perspective does not have sufficient elevation to support elements of Pleistocene refugia. The *Ficus* species predicted to occur on Monts Doudou are expected to have an associated fig wasp faunal richness of around 200–350 species.

## RÉSUMÉ

Trente espèces de Chalcidoidea vivant sur trois espèces de figuiers (*Ficus sansibarica macrosperma*, *F. louisii* et *F. elasticoides*) ont été inventoriées au Mont Doudou; 28 de ces espèces sont nouvellement découvertes doublant le nombre d'espèces connues au Gabon. Ces espèces ont seulement été récoltées aux alentours de Makokou. Même si, aujourd'hui, la majorité des guêpes de figuiers récoltées au Mont Doudou sont seulement connues du Gabon, la large distribution des figuiers suggère que ces guêpes pourraient également être présentes jusqu'au bassin du Congo, voire plus loin.

Sur les 105 figuiers afrotropicaux, 47 sont connus ou supposés être présents au Gabon, illustrant une riche représentation d'espèces de figuiers dans le pays. Ces espèces de figuiers sont ici listées avec les guêpes qui leur sont associées. À partir des données actuelles, la diversité minimale de guêpes associées aux figuiers du Gabon devrait être de 225 espèces, mais le nombre pourrait atteindre 400 à 500 espèces. Vingt à trente-cinq espèces de figuiers devraient se trouver au Mont Doudou qui, par la perspective des *Ficus*, n'a pas une élévation suffisante pour supporter des éléments de refuges du Pléistocène. Les

espèces de *Ficus* qui sont supposées se trouver au Mont Doudou devraient présenter environ 200 à 350 espèces de guêpes de figuiers associées.

## INTRODUCTION

The relationship between pollinating fig wasps (Chalcidoidea, Agaonidae) and their host fig trees (*Ficus*, Moraceae) is a classic example of an obligate mutualism, where neither partner can reproduce without the other, the wasp providing a pollination service and the fig tree in turn providing a breeding site for the pollinating wasp's progeny (Galil 1977; Janzen 1979). Besides the pollinator, each fig tree species has a diverse assemblage of non-pollinating fig wasps associated with it. The non-pollinating wasps are either phytophagous, galling the ovules as do the pollinators, or parasitoids of the gall formers (Compton and van Noort 1992; West and Herre 1994; West et al. 1996; Kerdelhué and Rasplus 1996a, 1996b). The mutualism between pollinating fig wasps and fig trees is usually a one-to-one relationship (Ramirez 1970; Wiebes 1979a; Wiebes and Compton 1990; Rasplus 1996) with each fig wasp species associated with a particular host fig tree species, of which there are approximately 750 worldwide (Berg 1989). There are, however, a few exceptions to this rule. A number of cases have been documented where two pollinator species are associated with a single host species (Compton et al. 1991; Michaloud et al. 1985; Michaloud et al. 1996; Berg and Wiebes 1992). Non-pollinating wasps appear to be almost as host-specific as the pollinators (Ulenberg 1985; van Noort 1994c).

In contrast to Bouček's (1988) classification, in which fig wasps were united under the single family Agaonidae, recent molecular investigations have shown that the Agaonidae is paraphyletic. Three of the constituent subfamilies of non-pollinating fig wasps (Sycococinae, Otitesellinae, and Sycoryctinae) were reassigned to the Pteromalidae, leaving the pollinating fig wasps in the Agaonidae (Rasplus et al. 1998). The true taxonomic affinities of the Sycophaginae and Epichrysomallinae remain undecided, but they do not belong in the Agaonidae. In addition, there are representatives of the Eurytomidae and Ormyridae that are also associated with figs in Africa.

Fig wasps are circumtropical in distribution, with about 230 described species of an estimated 700–1000 species in the Afrotropical region (van Noort and Rasplus 1997; van Noort unpublished). Fig wasps are exclusively associated with figs and since *Ficus* species richness is centered in the tropics, Gabon has a rich representation of species, with a total of 47 fig tree species recorded from, or predicted to, occur in the country (Berg et al. 1984). This high diversity is in line with other tropical African countries: Cameroon (58 species) (Berg et al. 1985), Tanzania (39), Kenya (34) and Uganda (43) (Berg and Hijman 1989). Given the pan-tropical distribution of *Ficus*, it is predictable that temperate countries such as South Africa support a lower diversity (22 species) (Berg 1990).

Local *Ficus* species richness is extremely high in Gabon. In the Lopé Reserve in central Gabon, which lies approximately 250 km northwest of Monts Doudou, at least 18 species of *Ficus* are present (White and Abernethy 1997). Thirty-four species have been recorded from the vicinity of Makokou in northeastern Gabon (Berg et al. 1984), with 28 hemi-epiphytic *Ficus* species recorded around the Institut de Recherches en Ecologie Tropicale station at M'Passa, situated 10 km south of Makokou (Nieder et al. 2001). Very few assessments of local fig wasp species richness have been conducted in Africa. During an ecological inventory survey of the fauna and flora occurring in Mkomazi Game Reserve in northeastern Tanzania (Coe et al. 1999), an assessment of fig tree and fig wasp species richness of this semi-arid east African savanna region was carried out (van Noort and

Compton 1999). Eighty-five species of fig wasp, of an expected species richness of 170, were reared from nine host fig tree species. For comparative purposes, van Noort and Compton (1999) demarcated an area in Kwazulu-Natal (South Africa) that was similar in size to Mkomazi Game Reserve, where 90 fig wasp species of a potential 117 species were recorded from 12 host fig tree species.

Research on fig trees and fig wasps in Gabon has centered on ecological and evolutionary investigations. These were conducted on *Ficus* species and their associated fig wasp assemblages in the vicinity of the Institut de Recherches en Ecologie Tropicale station at M'Passa, situated 10 km south of Makokou in northeastern Gabon (Gautier-Hion and Michaloud 1989; Michaloud 1982; 1988; Michaloud et al. 1985; Michaloud et al. 1996; Nieder et al. 2001). A number of fig wasp species have been described from collections made by Georges Michaloud and others in the vicinity of Makokou (Wiebes 1979b, 1979c, 1986, 1988, 1989; Michaloud et al. 1985; van Noort 1993a, 1993b, 1994a, 1994b, 1994c). Prior to the collections made on Monts Doudou only 26 described species of fig wasp had been recorded from Gabon (Berg and Wiebes 1992; van Noort, unpublished, see also web site at: <http://www.museums.org.za/sam/collect/life/ento/simon/figwasp.htm>), which is simply a function of a lack of collecting fig wasps in the region. Within Gabon all these species are only known from the vicinity of Makokou and for a number of them Makokou is the type (and currently only known) locality.

In this paper the sampled species richness of fig wasps on Monts Doudou is reported on and a summary of expected *Ficus* and fig wasp species richness is provided for Gabon and Monts Doudou. The biogeographical affinities of Gabon's fig wasps and fig trees are discussed.

## MATERIALS AND METHODS

### Study site

Monts Doudou is situated in Province Ogoové-Maritime in southwestern Gabon and straddles two reserves: Réserve de la Moukalaba-Dougoua and Réserve des Monts Doudou. Fig wasps were collected at three localities: 2°17.00'S, 10°29.83'E (110 m); 2°12.36'S, 10°25.11'E (110 m); 2°13.63'S, 10°23.67'E (660 m). The habitat is defined as coastal lowland rain forest (White 1983).

### Sampling methods

Fig wasps were collected on an opportunistic basis. The majority of fig trees that were located were stranglers in other tree species, and the fig crops were located in the forest canopy 30–50 m above the ground. Accessing the forest canopy could not be accommodated in the logistics of the survey and sampling of fig crops relied on locating figs that had been knocked to the forest floor. This was facilitated by the activities of primates feeding on ripe figs and by adverse weather conditions. One of the collections was made possible through a severe thunderstorm that knocked many figs to the forest floor. Figs were placed in a plastic jar with a gauze lid. Fig wasps that emerged were aspirated and preserved in 96% ethanol. After a couple of days the figs were split open and any fig wasps remaining within the fig cavity were extracted and preserved.

### Identification and analyses

Specimens were identified to family and subfamily, and where possible, to species. However, the majority of the species are undescribed and hence were sorted to

TABLE 1. Fig wasps reared from the *Ficus* species that were sampled on Monts Doudou. Family placement of the Epichrysoallinae is currently unresolved.

<i>Ficus</i> sp.	Agaonidae	Pteromalidae Sycocinae	Pteromalidae Oritesellinae	Pteromalidae Sycoryctinae	Family? Epichrysoallinae	Eurytomidae	Ormyridae
<i>F. sansibarica</i> <i>macrosperma</i>	<i>Courrella armata</i>	<i>Seres a. armipes</i>	<i>Oritesella</i> sp. 1	<i>Sycoscapteridea</i> sp. <i>Sycoryctes</i> sp. 1 <i>Sycoryctes</i> sp. 2 <i>Sycoryctes</i> sp. 3 <i>Watshamitella</i> sp. 1 <i>Watshamitella</i> sp. 2	<i>Camarothorax</i> sp. 1	<i>Sycophila</i> sp. 1 <i>Sycophila</i> sp. 2 <i>Sycophila</i> sp. 3	
<i>F. louisii</i>	<i>Paragon josephi</i>	<i>Crossogaster</i> sp.	<i>Oritesella</i> sp. 2 <i>Oritesella</i> sp. 3	<i>Sycoryctes</i> sp. 4 <i>Sycoryctes</i> sp. 5	<i>Camarothorax</i> sp. 2 <i>Camarothorax</i> sp. 3	<i>Sycophila</i> sp. 4	<i>Ormyrus</i> sp.
<i>F. elasticoides</i>	<i>Elisabethiella articulata</i>		<i>Oritesella</i> sp. 4 <i>Philosycus</i> sp. 3	<i>Sycoryctes</i> sp. 6 <i>Sycoryctes</i> sp. 7 <i>Watshamitella</i> sp. 3	<i>Camarothorax</i> sp. 4		

morpho-species. Owing to the limited number of samples it was not possible to carry out species richness analyses or to assess the effect of elevation on patterns of species richness. The collected material is deposited in the South African Museum, Cape Town. Representative specimens will be returned to Libreville, Gabon.

## RESULTS

Thirty fig wasp species, representing 12 genera and seven higher taxa at family or subfamily level, were reared from three species of fig tree: *Ficus sansibarica macrosperma* (Mildbr. and Burret) C. C. Berg; *Ficus louisii* Bout. and Leon; and *Ficus elasticoides* De Wild. The fig wasp faunal assemblages reared from these three host fig tree species are listed in Table 1. The forty-seven *Ficus* species that occur, or are predicted to occur, in Gabon, currently have a predicted associated fig wasp faunal assemblage of 225 species (Appendix A).

## DISCUSSION

### Species richness

Monts Doudou is only the second locality in Gabon that has been sampled for fig wasps. This survey added a further 28 species to the previously recorded total of 26 described species from the vicinity of Makokou in northeastern Gabon. Based on this total of 54 species in conjunction with the fig wasp species richness that has been recorded elsewhere in Africa from those *Ficus* species that occur in Gabon, at least 225 species of fig wasp are predicted to occur in this central African country (Appendix A). Seven *Ficus* species that occur, or are predicted to occur, in Gabon have never had their associated fig wasp faunas reared, and as such their pollinators and non-pollinating fig wasp faunas are unknown (Appendix A). In addition, the majority of the 47 *Ficus* species that occur in Gabon have not had their full assemblage of fig wasps reared from them any-

where within their distributional range in Africa. As such the estimate of 225 fig wasp species associated with Gabon's fig species is extremely conservative. As with many invertebrate taxa, the lack of alpha-level taxonomic and biogeographical knowledge of fig wasps is a function of insufficient sampling. The paucity of distributional information in Gabon is indicative of most of the rest of Africa, where there are still vast areas where no collecting of fig wasps has been undertaken. Collecting of fig wasps is hindered by the need to rear specimens from their host figs, a procedure which is constrained by the ecology of the mutualism. Fig crops are produced randomly throughout the year and individual trees produce crops at different times to each other, both essential traits to ensure the continued cycling of the mutualism (Bronstein, 1992). Because of this, most of the fig trees that are located during field surveys either have no figs or have figs at the wrong stage of development for rearing of fig wasps. On average only one out of every 30 trees has a fig crop at the right stage of development (pers. observ.). Furthermore, not every fig wasp species associated with a particular fig tree species is reared from every sample of figs. There are two reasons for this. First, not every fig crop borne by the tree has all the possible fig wasp species present, due to either the cycling of the mutualism, where the full fig wasp species complement does not locate every potential fig crop, or alternatively some fig wasp species may be absent from the local geographical area. Second, it is not practical to sample every fig in a particular crop. Since not all the fig wasp species associated with a particular fig crop will be breeding in every fig, rare species may be missed. To fully sample the fig wasp species assemblage associated with a fig tree species may require up to 23 collections from different trees of that species in a particular geographical area (Compton and Hawkins 1992; Compton et al. 1994; West et al. 1996). This is illustrated by an example from the New World where a single crop of *F. aurea* in Florida (USA) produced four species of fig wasp, a sample of 12 crops over time from the same tree produced seven species, and a sample of 60 crops from 23 different trees produced a total of nine species (Bronstein and Hossaert-McKey, 1996). Thus, the single samples collected from Monts Doudou *Ficus* are insufficient to assess fig wasp species richness associated with these host species.

The total of three *Ficus* species recorded for Monts Doudou is likely to be a small fraction of the total number of species occurring there. Based on assessments of local *Ficus* species richness in other areas of Gabon, such as a richness of at least 18 species of *Ficus* in the Lopé Reserve (White and Abernethy 1997) and 34 species within the vicinity of Makokou (Berg et al. 1984), around twenty to thirty-five fig tree species are predicted to occur on Monts Doudou, with an estimated associated fig wasp faunal richness of roughly 200–350 species. The estimation of fig wasp richness is based on known species richness of fig wasp assemblages associated with well-sampled fig tree species and the actual richness may be as much as three times greater, since up to 31 species of fig wasp have been recorded as being associated with a single *Ficus* species (van Noort and Compton 1999; J. Y. Rasplus pers. comm.). This, however, is tempered by the fact that the degree of host-specificity has not been determined for all of the non-pollinating groups of fig wasps, although the groups that have been revised so far show a high degree of specificity (Ulenberg 1985; van Noort 1994c). As such, a hypothesis that 10 wasp species are specific to each fig tree species may be a more realistic interpretation, albeit an extremely conservative one.

### Biogeography

*Ficus* endemism is low in Gabon with no species restricted to the country. However, three species are sub-endemic with a distribution encompassing Gabon and Cameroon: *F.*

*abscondita* C. C. Berg, *F. subsagittifolia* C. C. Berg, and *F. cyathistipula pringsheimiana* (Braun and K. Shum.) C. C. Berg (Berg et al. 1984). The nominate subspecies of *F. cyathistipula* Warberg has a wider distribution from Ivory Coast to Angola, N. Zambia, Kenya and Tanzania, but has a different species of pollinating wasp and a different assemblage of non-pollinating wasps, suggesting that these two subspecific taxa are distinct at species level. A further six Gabon species are restricted to the central African region. Eighteen of the Gabon species (plus a further two species that are predicted to occur in Gabon) are distributed through central and west Africa. The remaining Gabon species enjoy a more widespread distribution extending into east and southern Africa. Given this fairly widespread distribution of the *Ficus* species that occur in Gabon and the fact that all three of the sub-endemic Gabon species are lowland forest taxa, Monts Doudou is unlikely to have any endemic species. From a biogeographical perspective Monts Doudou does not have a high enough altitude to support (sub)montane *Ficus* species, and although the mountain has been postulated to be a Pleistocene refuge based on the presence of a number of *Begonia* species that occur towards the peak (Sosef 1994), the presence of *F. louisii*, a lowland forest species, on the peak (660 m) of Monts Doudou suggests that this elevation is within the climatic tolerance of widespread lowland *Ficus* species. Species with distributions conforming to Pleistocene refugia, such as *Ficus oreodryadum* Mildbr., which is predicted to occur in Gabon and is distributed from Uganda, Rwanda, Burundi to Cameroon, SE Nigeria and Fernando Po, are restricted to montane and submontane forest between 1300–2500 m (Berg et al. 1984), and the only likely locality that this species may be present in Gabon is on Mont Cristal. Given the obligate mutualism between fig wasps and fig trees, the above discussion concerning endemism and Pleistocene refugia will hold for fig wasps as well. However, this assumption needs to be treated with caution as not all fig wasp species are distributed throughout the range of their host fig tree species (Compton et al. 1994).

Biogeographical affinities of Monts Doudou fig wasps could only be ascertained for the four described species that were collected. *Courtella armata*, the pollinator of *Ficus sansibarica*, has been reared from both subspecies of this host, the nominate subspecies and *F. sansibarica macrosperma*, in Ivory Coast, Nigeria, Cameroon, Zambia, Zimbabwe and South Africa (Wiebes 1986; Berg and Wiebes 1992; van Noort, unpub.). This is the first published record of this species from Gabon. *Ficus sansibarica* is a widespread Afrotropical species distributed from eastern South Africa and northern Angola north to Kenya and Uganda and west to Guinea-Bissau (Berg and Wiebes 1992), and the pollinator would be expected to exhibit the same distributional pattern. *Seres armipes*, a non-pollinating sycoecine fig wasp reared from *F. s. macrosperma* on Monts Doudou, was described from specimens reared from *Ficus ovata*, which is pollinated by *Courtella hamifera* Kieffer, and has been recorded from Ivory Coast, Cameroon and Uganda associated with *Ficus ovata*. *Seres armipes* has previously been recorded from *Ficus sansibarica macrosperma* in Ivory Coast and Zambia (van Noort 1993a), but this is the first record of this species from Gabon. *Paragaon josephi*, the pollinator of *Ficus louisii*, is only known from Gabon having been described from specimens reared from *F. louisii* at Makokou (Wiebes 1986). However, the species is likely to be more widespread as *F. louisii* is a central and west African species recorded from Democratic Republic of the Congo, Gabon, Cameroon and Guinea (Berg and Wiebes 1992). DNA has been successfully extracted from the samples of *Paragaon josephi* Wiebes collected on Monts Doudou as part of an investigation into the phylogeny and evolution of fig-pollinating wasps at generic level (J. M. Cook, V. Bull, and C. Lopez Vaamonde in prep.). The *Crossogaster* species that was reared

from this fig tree is undescribed. This sycoecine genus was recently revised (van Noort 1994a) and the species associated with *F. lousii* is distinct from the 16 described *Crossogaster* species. *Elisabethiella articulata*, the pollinator of *F. elasticoides*, has previously been reared from this host species in Gabon (Makokou) (Wiebes 1986), and has also been collected in a Berlese trap (Equatorial Guinea) and at light (Ivory Coast) (Berg and Wiebes 1992). *Ficus elasticoides* is a lowland rain forest species distributed from Angola to Cameroon and is also present in Ivory Coast (Berg and Wiebes 1992). The remainder of the fig wasps that were reared from the 3 sampled fig tree species are likely to be undescribed species, but this is difficult to ascertain without the revision of the groups in question having been completed (van Noort, in prep.).

In summary, the sampling of fig wasps during the survey of Monts Doudou was done on an opportunistic basis. Consequently, it is likely that many further species of *Ficus* still wait to be recorded, each with its own host-specific fig wasp fauna. In addition, the fig wasp species richness recorded from the three sampled fig tree species on Monts Doudou is currently an under-representation, given the limited sampling effort. For both these reasons, the results are a gross underestimation of fig wasp species richness in this locality. Nevertheless, indications are that Gabon supports a rich *Ficus* and fig wasp fauna, a factor that will likely hold for Monts Doudou as well.

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#### APPENDIX A

Checklist of fig tree species recorded from Gabon or predicted to occur there (after Berg et al. 1984; nomenclature updated), and including a list of the predicted associated fig wasp fauna for each *Ficus* species based on collections made elsewhere in Africa. The fig wasp species that have been recorded (both previously and during this survey) from Gabon are indicated in bold text. Habitat associations of fig tree species are after Berg and Wiebes (1992). Distributions of the fig tree species are summarised as Southern Africa (S); East Africa (E); Central Africa (C) and West Africa (W).

#### *FICUS* OF GABON

*SYCIDIUM* (subgenus)

*SYCIDIUM* (section)

1. *F. exasperata* Vahl (S, E, C, W AFRICA) Forest up to 1800 m  
*Kradibia gestroi afrum* (Wiebes)  
*Sycoscapteridea longipalpus* (Joseph)  
*Philotrypesis quadrisetosa* (Westwood)  
*Sycoryctes* sp.

2a. *F. asperifolia* Miq. (E, C, W AFRICA) Wet and dry forest along streams  
***Kradibia gestroi afrum*** (Wiebes)

2b. *F. asperifolia* Miq. ("variety" *urceolaris*)  
*Kradibia hilli* Wiebes

*SYCOMORUS* (subgenus)

3. *F. mucoso* Ficalho (E, C, W AFRICA) Forest

*Ceratosolen arabicus* Mayr

*Ceratosolen galili* Wiebes

*Apocrypta crypta* Ulenberg

*Apocryptophagus* sp. A

*Apocryptophagus* sp. B

4. *F. sur* Forsk. (S, E, C, W AFRICA) Woodland and forest

*Ceratosolen silvestriamus* Grandi

*Ceratosolen flabellatus* Grandi

*Sycophaga cyclostigma* Wiebes

*Sycophaga silvestrii* Grandi

*Apocryptophagus* sp. A

*Apocryptophagus* sp. B

*Apocryptophagus* sp. C

*Apocryptophagus* sp. D

*Apocrypta guineensis* Grandi

*Apocrypta* sp. B

*Sycoscapter nigrum* Risbec

*Sycoscapter* sp. B

*Watshamiella* sp. A

*Watshamiella* sp. B

*Watshamiella* sp. C

*Camarothorax* sp.

*Sycophila* sp.

*Acophila* sp.

5. *F. vogeliana* (Miq.) Miq. (E, C, W AFRICA) Riverine and swamp forest

*Ceratosolen acutatus* Grandi

*Sycophaga* sp.

*Apocryptophagus* sp. A

*Apocryptophagus* sp. B

*Apocrypta* sp.

*Watshamiella* sp.

*PHARMACOSYCEA* (subgenus)

*OREOSYCEA* (section)

6. *F. variifolia* Warb. (E, C, W AFRICA) Wet and dry forest up to 1300 m

***Dolichoris flabellata*** Wiebes

7. *F. dicranostyla* Mildbr. (E, C, W AFRICA) Savanna woodland up to 1500 m



*Dolichoris flabellata* Wiebes

## UROSTIGMA (subgenus)

## UROSTIGMA (section)

8. *F. ingens* (Miq.) Miq. (S, E, C, W AFRICA) (Predicted to occur in Gabon) Woodland*Platyscapa soraria* Wiebes*Otitesella rotunda* van Noort*Otitesella longicauda* van Noort*Sycoryctes* sp. A*Sycoryctes* sp. B*Sycoryctes* sp. C*Philotrypesis* sp.

## GALOGLYCHIA (section)

## GALOGLYCHIA (subsection)

9. *F. lutea* Vahl (S, E, C, W AFRICA) Forest up to 1800 m*Allotriozoon heterandromorphum* Grandi*Philocaenus silvestrii* (Grandi)*Sycoryctes* sp. A*Sycoryctes* sp. B*Sycoscapter* sp.*Watshamiella* sp.*Philotrypesis selenetica* Grandi*Philotrypesis* sp.*Otitesella africana* Grandi*Otitesella* sp. B*Camarothonax* sp. A*Camarothonax* sp. B*Sycophila* sp. A*Sycophila* sp. B*Sycophila* sp. C*Sycophila* sp. D*Sycophila* sp. E

## PLATYPHYLLAE (subsection)

10. *F. recurvata* De Wildeman (C, W AFRICA) Forest at low altitudes11. *F. jansii* Boutique (C AFRICA) (Predicted to occur in Gabon) Forest up to 1500 m12. *F. trichopoda* Baker (S, E, C, W AFRICA)*Elisabethiella bergi* Wiebes*Crossogaster robertsoni* van Noort*Philocaenus hippopotomus* van Noort*Sycoryctes* sp. A*Sycoryctes* sp. B*Sycoscapter* sp. A*Sycoscapter* sp. B*Philotrypesis* sp.

*Otitesella* sp.  
*Watshamiella* sp. A  
*Watshamiella* sp. B  
*Camarothorax* sp.

CHLAMYDODORAE (subsection)

13. *F. calyptrata* Vahl (= *F. mallotoides*) (C, W AFRICA) Forest up to 700 m  
*Elisabethiella pectinata* (Joseph)
14. *F. amadiensis* De Wild (E, C AFRICA) (Predicted to occur in Gabon) Woodland up to 2100 m
15. *F. craterostoma* Mildbr. and Burret (S, E, C, W AFRICA) Forest up to 2100 m  
***Alfonsiella michaloudi* Wiebes**  
***Philocaenus liodontus* (Wiebes)**  
***Philocaenus insolitus* van Noort**  
*Sycoryctes* sp.  
*Otitesella* sp.
16. *F. linqua linqua* De Wild. and T. Durand (E, C, W AFRICA) Forest up to 1200 m  
***Alfonsiella michaloudi* Wiebes**  
***Philocaenus liodontus* (Wiebes)**
17. *F. natalensis leprieurii* (Miq.) C. C. Berg (C, W AFRICA) Forest, woodland up to 1200 m  
***Alfonsiella fimbriata* Waterston**  
***Philocaenus liodontus* (Wiebes)**
18. *F. thonningii* Bl. (S, E, C, W AFRICA) Wet and dry forest up to 2000 m  
*Elisabethiella stuckenbergi* Grandi  
*Alfonsiella brongersmai* Wiebes  
*Alfonsiella longiscapa* Joseph  
*Philocaenus barbarus* (Grandi)  
*Crossogaster odorans* Wiebes  
*Philotrypesis parca* Wiebes  
*Sycoscapter cornutus* Wiebes  
*Sycoryctes remus* Wiebes  
*Sycoryctes hirtus* Wiebes  
*Watshamiella alata* Wiebes  
*Watshamiella* sp. A  
*Watshamiella* sp. B  
*Otitesella tsamvi* Wiebes  
*Otitesella* sp. B  
*Camarothorax brevimucro* Bouček  
*Camarothorax equicollis* Bouček  
*Camarothorax longimucro* Bouček  
*Sycotetra serricornis* Bouček  
*Eurytoma ficusgallae* Bouček

*Ficomila curtivena* Bouček  
*Ficomila gambiensis* (Risbec)  
*Syceurytoma ficus* Bouček  
*Sycophila flaviclava* Bouček  
*Sycophila kestraneura* (Masi)  
*Sycophila modesta* Bouček  
*Sycophila naso* Bouček  
*Sycophila punctum* Bouček  
*Sycophila sessilis* Bouček  
*Ormyrus flavipes* Bouček  
*Ormyrus subconicus* Bouček  
*Ormyrus watshami* Bouček

19. *F. kamerunensis* Mildbr. and Burret (C, W AFRICA) Forest at low altitudes  
*Alfonsiella fimbriata* Waterston  
*Philocaenus liodontus* (Wiebes)

CRASSICOSTAE (subsection)

20. *F. elasticoides* De Wild. (C, W AFRICA) Forest at low altitudes  
*Elisabethiella articulata* (Joseph)  
*Otitesella* sp. A  
*Philosycus* sp.  
*Sycoryctes* sp. A  
*Sycoryctes* sp. B  
*Watshamiella* sp.  
*Camaro thorax* sp.
21. *F. burretiana* Hutch. (C AFRICA) Forest at low altitudes  
*Elisabethiella longiscapa* Wiebes
22. *F. oreodryadum* Mildbr. (C, W AFRICA) (Predicted to occur in Gabon) (Sub)montane forest 1300–2500 m
23. *F. pseudomangifera* Hutch. (C, W AFRICA) Forest up to 1200 m  
*Nigeriella letouzeyi* Wiebes
24. *F. adolfi-friderici* Mildbr. (C, W AFRICA) Forest at low altitudes
25. *F. louisii* Boutique and J. Léonard (C, W AFRICA) Forest at low altitudes  
*Paragaon josephi* Wiebes  
*Crossogaster* sp.  
*Otitesella* sp. A  
*Otitesella* sp. B  
*Sycoryctes* sp. A  
*Sycoryctes* sp. B  
*Camaro thorax* sp. A  
*Camoro thorax* sp. B  
*Sycophila* sp.

***Ormyrus* sp.**

26. *F. leoneensis* Hutch. (C, W AFRICA) (Predicted to occur in Gabon) Forest

*CYATHISTIPULAE* (subsection)

27. *F. conraui* Warb. (C, W AFRICA) Forest

*Agaon kiellandi* Wiebes

28. *F. tessellata* Warb. (C, W AFRICA) Forest, often riverine, up to 1900 m

*Agaon taiense* Wiebes

*Sycoecus bergi* van Noort

29a. *F. ardisioides ardisioides* Warb. (C AFRICA) (Predicted to occur in Gabon) Forest at low altitudes

29b. *F. ardisioides camptoneura* (Mildbr.) C. C. Berg (C, W AFRICA) Forest at low altitudes

*Agaon megalopon* Wiebes

*Philotrypesis* sp.

30. *F. preussii* Warb. (C, W AFRICA) Forest up to 1200 m

*Agaon* sp.

31. *F. abscondita* C. C. Berg (C AFRICA) Forest at low altitudes

*Agaon* sp.

32a. *F. cyathistipula cyathistipula* Warb. (E, C, W AFRICA) Forest, often riverine up to 1800 m

***Agaon fasciatum* Waterston**

*Sycoecus thaumastocnema* Waterston

32b. *F. cyathistipula pringsheimiana* (Braun and K. Shum.) C. C. Berg (C AFRICA) Forest at low altitudes

***Agaon kiellandi* Wiebes**

*Sycoecus oculabulbus* van Noort

*Sycoryctes* sp.

33. *F. cyathistipuloides* De Wild. (C, W AFRICA) Forest at low altitudes

*Agaon obtusum* Wiebes

*Sycoecus wiebesi* van Noort

*Watshamiella* sp. A

*Watshamiella* sp. B

*Watshamiella* sp. C

*Philotrypesis* sp.

34. *F. densistipulata* De Wild. (C AFRICA) Forest up to 1250 m

***Agaon kiellandi* Wiebes**

35. *F. subcostata* De Wild. (C AFRICA) Forest at low altitudes

***Agaon acutatatum* Wiebes**

- 36.
- F. barteri*
- Sprague (C, W AFRICA) Forest up to 1200 m

***Agaon paradoxum* Dalman**

- 37.
- F. subsagittifolia*
- C. C. Berg (C AFRICA) Forest at low altitudes

***Agaon cicatriferens multum* Wiebes*****Sycoecus wiebesi* van Noort**

- 38.
- F. wildemaniana*
- De Wild. and T. Durand (C AFRICA) Forest up to 1100 m

***Agaon gabonense* Wiebes**

## CAULOCARPAE (subsection)

- 39a.
- F. ottoniifolia ottoniifolia*
- (Miq.) Miq. (C, W AFRICA) Open forest up to 1600 m

***Courtella camerunensis* (Wiebes)*****Courtella gabonensis* Wiebes**

- 39b.
- F. ottoniifolia lucanda*
- (Ficalho) C. C. Berg (C AFRICA) Wet to dry forest up to 1500 m

*Courtella scobinifera* (Waterston)*Philocaenus levis* (Waterston)

- 40.
- F. tremula kimuenzensis*
- (Warb) C. C. Berg (C, W AFRICA) Forest at low altitudes

- 41.
- F. artocarpoides*
- Warb. (C, W AFRICA) Forest up to 1200 m

***Courtella penicula* (Wiebes)*****Courtella hladikae* (Wiebes)*****Seres longicalcar* van Noort*****Crossogaster michaloudi* van Noort*****Philocaenus rasplusi* van Noort**

- 42.
- F. polita polita*
- Vahl (S, E, C, W AFRICA) Forest up to 1200 m

*Courtella bekiliensis* (Risbec)*Seres solweziensis* van Noort*Sycoryctes* sp. A*Sycoryctes* sp. B*Sycoscapter* sp.*Sycoscapteridea* sp.*Watshamiella* sp.*Philotrypesis* sp.*Otitesella* sp.*Camarothonax* sp.*Sycophila* sp. A*Sycophila* sp. B

- 43.
- F. sansibarica macrosperma*
- (Mildbr. and Burret) (C, W AFRICA) Forest and woodland up to 1200 m

***Courtella armata* (Wiebes)*****Seres armipes* Waterston**

*Seres solweziensis* van Noort

***Oritesella* sp.**

***Sycoryctes* sp. A**

***Sycoryctes* sp. B**

***Sycoryctes* sp. C**

***Sycoscapteridea* sp.**

*Sycoscapter* sp.

***Watshamiella* sp. A**

***Watshamiella* sp. B**

***Camarothorax* sp.**

***Sycophila* sp. A**

***Sycophila* sp. B**

***Sycophila* sp. C**

44. *F. dryepondtiana* De Wild. (C AFRICA) Forest at low altitudes

***Courtella sylviae* Wiebes**

45. *F. umbellata* Vahl (C, W AFRICA) Forest and woodland at low altitudes

*Courtella medleri* (Wiebes)

46. *F. bubu* Warb. (S, E, C, W AFRICA) Forest and woodland up to 1200 m

***Courtella michaloudi* (Wiebes)**

*Seres wardi* van Noort

*Sycoryctes* sp. A

*Sycoryctes* sp. B

*Sycoryctes* sp. C

*Sycoryctes* sp. D

*Sycoryctes* sp. E

*Sycoryctes* sp. F

*Sycoscapter* sp.

*Sycoscapteridea* sp.

*Philotrypesis* sp.

*Watshamiella* sp. A

*Watshamiella* sp. B

*Oritesella* sp.

*Philosycus* sp.

*Camarothorax* sp. A

*Camarothorax* sp. B

*Camarothorax* sp. C

*Camarothorax* sp. D

nr. *Camarothorax* sp.

*Ficomila* sp.

*Sycophila* sp. A

*Sycophila* sp. B

*Sycophila* sp. C

*Sycophila* sp. D

*Sycophila* sp. E

*Sycophila* sp. F

*Sycophila* sp. G  
*Sycophila* sp. H  
*Ormyrus* sp.

47. *F. ovata* Vahl (S, E, C, W AFRICA) Forest, often riverine and woodland up to 2100 m  
*Courtella hamifera* Kieffer  
*Seres armipes* Waterston  
*Seres solweziensis* van Noort  
*Crossogaster ovata* van Noort  
*Sycoryctes* sp. A  
*Sycoryctes* sp. B  
*Watshamiella* sp.  
*Philotrypesis africana* Grandi  
*Philotrypesis* sp. B  
*Philosycus monstruosus* (Grandi)  
*Otitessella* sp.

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